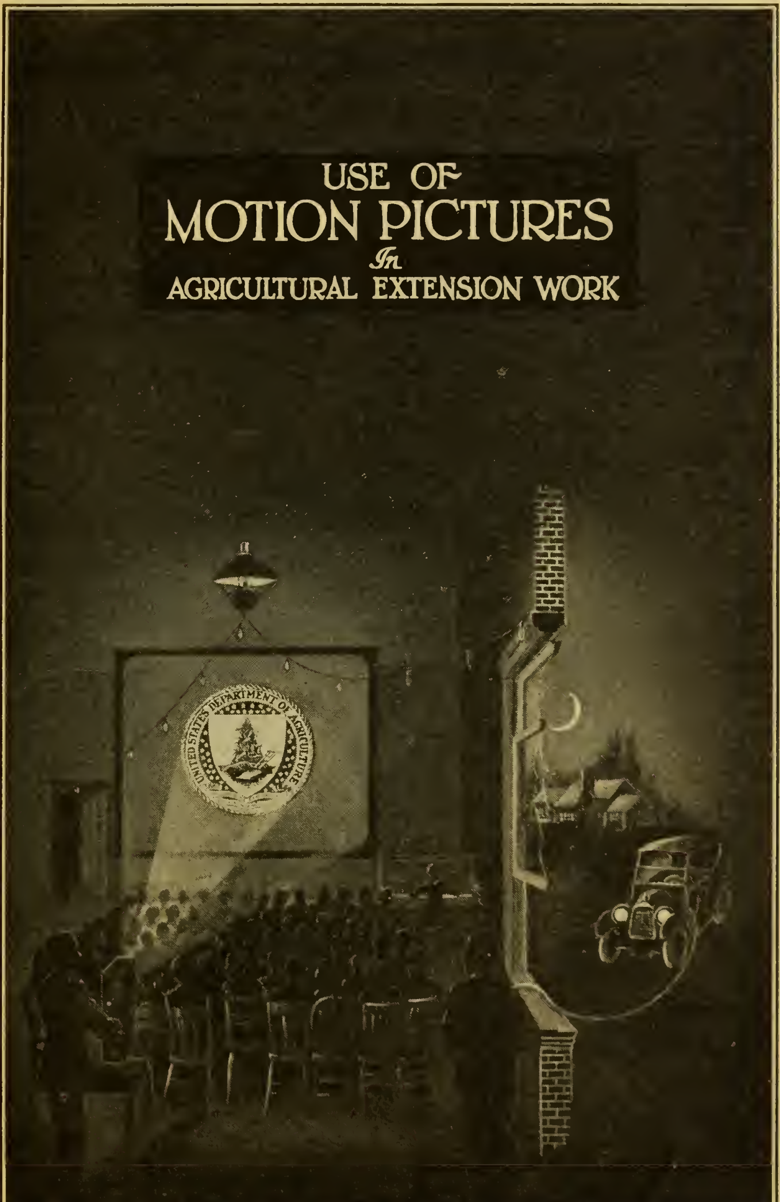
UNITED STATES DEPARTMENT OF AGRICULTURE

MISCELLANEOUS CIRCULAR No. 78

WASHINGTON, D. C. NOVEMBER, 1926



ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY

USE OF MOTION PICTURES IN AGRICULTURAL EXTENSION WORK

FRED W. PERKINS, Administrative Officer, in Charge; HOWARD GREENE, Technical Animator; and GEORGE R. GOERGENS, Administrative Assistant, Office of Motion Pictures, Extension Service

CONTENTS

"The agricultural extension agent contemplating the purchase of a motion-picture projecting machine may expect late hours, some worry, considerable expense for upkeep," wrote Roy E. Gwin, a county agent in Kansas, "but he can reach three times the number of people that can be reached in any other way."

The sense of this statement is repeated many times in recent expressions to the United States Department of Agriculture from extension agents, field employees, and others who are systematic users of educational motion pictures. Practically all the statements favor the use of films in agricultural extension work. Some are more sweeping than the quoted statement, others are less enthusiastic. A few believe that other visual material is more effective than films, but motion pictures are favored by a convincing mass of testimony.

Largely on the basis of these statements, but including much other material that has accrued during the dozen years in which the Department of Agriculture has been making and circulating educational films, this circular has been prepared to help extension agents about to begin the use of films, and to reduce the "late hours, worry, and expense for upkeep" of the present users.

If questions that have been overlooked present themselves to extension agents and other department workers reading this circular, the Office of Motion Pictures will endeavor to answer them upon request.

COOPERATION WITH SCHOOLS, THEATERS, AND OTHER AGENCIES

The extension agent is reminded that he need not possess a projector in order to use motion pictures in his work. Pictures often may be shown in cooperation with schools, churches, lodge halls, theaters, and other institutions equipped for motion pictures. The exact form of the cooperation is subject to the initiative and con-

tacts of the agent, but a few suggestions may help. The showing of films in rural schools is sure to interest the farmers of the community, because the children will carry home some of the information thus received. The showing of films in city schools is likely to bring indirect benefits, in that it will interest the city people in the problems of the farmers of the surrounding country and in the work designed to solve those problems. Churches in general are open to meetings for community betterment, and many are now equipped for showing pictures. Theaters, especially in the smaller towns, are frequently eager to arrange special exhibitions of films for farmers. The theater is benefited, because the crowd at the free show is likely to come back and pay for an entertainment program. Newspapers, especially those that strive for rural circulation and influence, frequently cooperate in such undertakings, and such publicity is a strong argument with the operator of a theater. Farmers' organizations, chambers of commerce, Rotary clubs, Kiwanis clubs, Boy Scout troops, and women's clubs are examples of the groups that can be interested in cooperation of this sort.

In Centerville, Tenn., the business men's club raised a fund to pay a theater's actual expense in running free shows of agricultural films on two Saturday afternoons each month. The theater was glad of the chance to bring new people through its doors. The merchants benefited from the larger number of people who came to town. The county agent extended his contacts. The farmers learned something useful.

Theaters frequently use Government educational films on their regular programs, especially if the newspaper publicity is liberal. This expedient is valuable to the extension agent when he is trying to interest the city people in a project or campaign, such as a drive for the eradication of animal tuberculosis. The Department of Agriculture has no objection to the use of its films on programs for which admission is charged, so long as the department film is an added feature of the regular program.

Another form of theatrical cooperation is in the giving of special shows for school children or housekeepers or other special groups.

The theater is regarded primarily as a place of amusement, and theater patrons are likely to object to too much education on an amusement program. On the other hand, nearly every theater owner is on the lookout for opportunities to tie up his theater with the development and prosperity of the community.

PROJECTING THE PICTURE

The agent who has his own projection equipment is his own cooperator, although he should not forget the advantage of working with the agencies just mentioned. With his own machine, he can carry his film message to any place in his county where there is electric current, and if he has portable generating equipment he can show his films in any locality he desires. The most striking results recorded in the use of Department of Agriculture films have been those in which the films were carried to the people with portable generators and projectors and were shown in the surroundings where they would have most effect. In many instances Depart-

ment of Agriculture films thus exhibited in some out-of-the-way church or schoolhouse or in some secluded grove have given the local population its introduction to the "magic of the silver screen." Instances are recorded of women with babies in their arms walking 10 miles and standing for 90 minutes to witness such exhibitions. In another case a farmer with his entire family followed a Department of Agriculture "movie" truck for three days; they saw the same films in different localities on three successive evenings, and seemed to get more benefit from them with each repetition.

NECESSARY EQUIPMENT

In the few counties where electric current is available in every community the agent need not concern himself with a portable

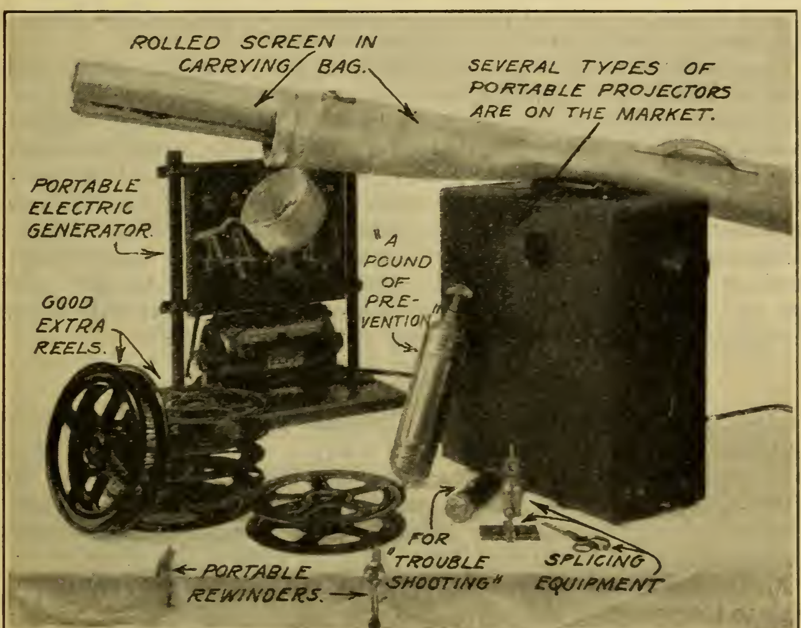


FIG. 1.—Portable equipment for motion-picture projection

source of current. He will simply plug into the nearest lamp socket. In general, however, the agent will need the following items of equipment (fig. 1):

A portable projecting machine.
A portable source of current.
A portable screen.
A fire extinguisher.

The following additional items are not absolutely essential, but are very desirable:

Six extra reels or spools in the best condition.
A pair of rewinders.
A mending or splicing outfit, with film cement and scissors.
A pocket flashlight, or extra bulb with wire, for use in threading the projector or in locating trouble in it.

Extension agents who could not finance projection outfits from their regular operating funds have been helped by county farmers' organizations, commercial, and other organizations in the cities and towns.

PROJECTORS

Portable projectors vary in size and shape but average the proportions of a suit case. Their essential parts include an incandescent light of considerable intensity; an intermittent movement, operated by hand or by a motor, which, by means of sprockets, pulls the film from one receptacle to another, and between the receptacles holds each separate " frame " or picture of the film for an instant in the path of the light; and a lens, which gathers and focuses the rays of light at a variable distance. The machine has other important parts, such as a shutter, which cuts off the light rays for the fraction of a second during which an individual picture is being pulled from the light path to make way for another picture.

Standard portable projectors cost from $200 to $350. The average is $250. Several types that have been on the market for some years are well established and in wide use among agricultural extension workers. Choice between them is largely one of personal preference. The machines are furnished with or without motors, and the motors may be of different types, and interchangeable. The machines may be adapted for any ordinary system of electric current, and some extraordinary ones. The manufacturers are making a specialty of meeting problems in this field. Most of them offer to give advice for any particular set of conditions, and all of them will furnish complete instructions for the operation of the machines.

HINTS ON PROJECTOR OPERATION

Manufacturers state that if a machine passes safely through the first few months in the hands of an inexperienced operator it should give good service thereafter. They say many inexperienced users often ignore, or read hastily and perfunctorily, their instruction books; and many make the mistake of playing with adjustments, turning screws, and moving levers with no idea of the effect.

As the combined result of the two errors, mechanical mortality is high in the early period.

Do not try to do anything with your machine until you know something about it, and then—

Do as little as possible. Let well enough alone unless you know how to make it better. And—

Follow the instructions to the letter.

Any attempt to give detailed instructions for the operation of the various portable projectors on the market would result merely in a duplication of the instructions that go with the machines. The prospective operator is therefore referred to such instructions and urged to study them. There are some points, however, that call for special emphasis and that have bearing more or less on all projectors.

KEEP THE PROJECTOR CLEAN

Among nine projectors sent to a shop for overhauling and repair, the interiors of seven were found to be reeking with grease, oil, and

dirt. According to the repairman, sloppy use of lubricants and failure to keep clean the parts that are not visible from the outside are responsible for a very large part of the troubles of the average projector. Insulation is softened and impaired; electrical contacts are made imperfect; motor commutators are carbonized and brushes make poor contacts; oil works into the gate and gets into the tracks or runners and on the sprockets and film; lenses and condensers are clouded; and belts become saturated with oil, and begin to slip. This last fact is responsible for not a little of the trouble that so often occurs with "take-ups." A dry belt on a dry pulley will do its work without excessive tension, but an oily belt is treacherous and uncertain. Leather will soak up an amazing quantity of oil, and it is very difficult to remove it completely. Wash an oily belt thoroughly with gasoline and put it back on the job, and in a short time it will be found oily again from lubricant working out from the inside. Repeated soaking in gasoline and drying will in time effect a remedy, but it is far better to put in new belts and keep them clean.

Everything about the film gate must be kept immaculate. Tracks must be frequently cleaned; there is always danger that a particle of emulsion may stick to the tracks, increase in size by scraping more emulsion off film as it passes, and make scratches. Further, the cleanliness of the gate has an important bearing on the steadiness of the projection.

If the runners can not be cleaned with a soft, dry cloth, use a little kerosene or gasoline. The finger nail is a useful tool for removing specks of emulsion. Under no circumstances use sandpaper or any metal object, for the inevitable result will be scratches, which will gouge emulsion out of the next film that is run through and make the trouble worse.

There is a great difference in the light given off by a clean and by a dirty bulb. Yet it is a common thing to see an operator grasp a bulb in greasy fingers and put it in place, without wiping off the grime. A combination of dirty lamp, dirty reflector, dirty condenser, and dirty lenses may cut down the light nearly 50 per cent. Keep every part of the projector clean. If it shows a tendency to become oily, wipe out as often as necessary with a cloth dampened with gasoline. Dirt is one of the worst enemies of the projector

LUBRICATE THE ROLLERS

A point often overlooked is the lubrication of the little rollers that guide and support the film. Many a projector, otherwise in good shape, will have its rollers gummed up and sometimes incapable of turning under the film. Rollers that turn hard—and they turn hard if the film will not move them—should be cleaned with gasoline to wash out gummed oil, followed by lubrication with light oil. The oil must be confined to the places to be lubricated, for getting it on the rollers means spreading it along the film.

REPLACE WORN SPROCKETS

In an hour's projection a half million perforations—a quarter million on each side—pass over the sprockets. Their constant cutting tendency eventually wears the sprockets to sharp hooks. The worn

teeth cut the perforations and cause an unsteady picture on the screen. The damage to film is serious, for once perforations are mutilated they rapidly become worse. The trouble may be minimized or postponed by keeping the projector, particularly the gate, clean, and by adjusting the tension or pressure on the film. Worn sprockets should be immediately replaced. The sooner this is done the fewer will be the films damaged and the better will be the screen results from the projector.

SET THE LAMP RIGHT

Always see that the lamp is set with the filament at right angles to the line of light—that is, crosswise to a line reaching from the lamp to the lens. Lack of regard for this point makes a great deal of difference in the lighting—more in some lamps than others, but always some.

WATCH THE LOOPS

In threading, look out for the loops. Too short a loop may tear sprocket holes (perforations), break the film, make it run off the sprockets, or cause unsteady projection. Too much loop means scratches or tears, to say nothing of the annoyance and inconvenience of having to stop the machine, untangle the film, and get going again.

ELECTRICITY FOR THE PROJECTOR

All projectors require electricity for their operation. Most kinds have small electric motors for running the film; a few are without motors and are hand-cranked. All must have electric illumination. In all cases, therefore, the supply of current is a matter of first importance.

Public electric mains may supply either alternating current or direct current. The standard voltage is 110; in rare instances it is 220. In all cases the electrical equipment of the projector must be such that it will operate on the available current. A lamp will burn equally well on alternating or direct current, provided the voltage is correct. Motors are made in three types, (1) for alternating current, (2) for direct current, or (3) universal, which means that they operate equally well on alternating or direct current ("A. C." or "D. C"). Practically all projector motors are of the universal type. The possessor of a projector with a motor that is not universal should not try to use it with the wrong kind of current.

A projector with 32-volt electrical equipment can be used with 110-volt current, if it is provided with a rheostat or a transformer for reducing the voltage. Such reducing equipment can be purchased for about $25, in addition to which it will cost from $5 to $10 to have the necessary changes and connections made in the wiring. There are projectors on the market with such a rheostat already built in.

PORTABLE SOURCES OF CURRENT

If the projector is to be used where there is no supply of electricity, it will be necessary to provide a generator (fig. 1), with means for driving it, or storage batteries.

Generators are built in three general types. One is a complete self-contained plant, including a small gasoline engine to drive the generator. Another is attached to the running board of an automobile and is driven by a belt running over the tire of the jacked-up rear wheel. The third is mounted on or near the engine and is provided with special driving means, taking power direct from the engine of the car.

Storage batteries may very often be rented from garages. They have the advantage of being compact, clean, simple, and easy to handle. After use they are simply returned to the garage.

The storage battery is, in effect, a tank of electricity and its capacity is limited by the size and number of its plates. When it has been run out it is of no further use until it has been recharged. The generator will provide a supply of electricity as long as there is power to drive it. Batteries are easier to handle, simpler, and, in the long run, generally cheaper than a generating plant. A generating plant, on the other hand, can be used anywhere and at any time, and is necessary where there is no public current supply and no place where batteries can be obtained.

In an emergency it is practicable to take the storage batteries from several automobiles, connect them as may be required, and use them to run the projector. (See appendix for making connections for voltage, etc.)

A projector used with storage batteries should be of the 32-volt type. It is not practicable to hook up enough batteries to give 110 volts.

A number of firms build electric lighting plants for farm use, and representatives of these firms often are willing to lend or rent portable generating plants for motion-picture exhibitions.

SCREENS

Three general qualities determine the efficiency of the ordinary type of screen—(1) a reasonably smooth surface and perfect flatness without waves or wrinkles; (2) a light color; and (3) opaqueness, so that little or no light will pass through. The last item is of great importance. As the picture thrown on the screen is seen clearly in proportion to the amount of light reflected, or thrown back, from the screen's surface, it follows that if some of the light goes through the screen, there will be a smaller quantity left to be reflected; hence the picture will be less clear.

WALLS AND WINDOW SHADES

A light-colored wall makes a good screen, largely because of its absolute opacity. If a picture can be projected on a light buff wall, it will give pleasing results, both in clearness and in tone. A heavy window shade of the common roller type, in a light buff color, makes a screen that is effective as well as convenient, portable, and inexpensive. These shades can be obtained in a wide range of sizes. Care should be taken to see that the roller is perfectly straight; often, especially in the larger sizes, the rollers are not straight, and the result will be an uneven screen surface. The roller can be mounted

in its brackets on a strip of wood, which may be permanently fastened in place or temporarily hung up, as may be required. The usual very light batten at the bottom should be replaced by a heavier, stiffer rod that will hold the screen down and keep it flat.

OIL CLOTH AND SATEEN

Another good screen material is common oilcloth with a light-colored back, for it is the back that is used. If carefully handled this can be rolled on a good-sized roller for a long time without cracking. Heavy white sateen is also good.

CARRYING CASES

The foregoing applies more particularly to portable screens that the user expects to carry from place to place. A good carrying case for such a screen can be made of canvas, in shape something like an elongated golf bag, with a buckled cover for fastening after the screen has been rolled and shoved inside (fig. 1).

STATIONARY SCREENS

If a stationary screen is desired and a smooth wall is available, complete satisfaction should come from coating the wall with any of the standard commercial varieties of calcimine in white or cream color. The white surface should be the size of the picture expected and in the proportion of 3 vertical to 4 horizontal—that is, the proportion of the standard motion picture. When the white surface is completed, paint a heavy black line, 1 or 2 inches wide, all around it. This will make the projection appear steadier.

PATENTED SCREENS

Many patented screens are on the market. Prices range from about 30 cents a square foot upwards. Some of the screens with metallic surfaces are very good, others are too brilliant and produce a distinct glare that makes the picture look brighter in one area than another, the position of the brighter area depending on the angle between the beam of light and the line of vision.

HANGING THE SCREEN

In hanging a screen there is more to be considered than merely flatness and immovability, although the latter is very important. If the screen is hung high and the projector must be kept low, it will be necessary to tilt the projector. If the screen is not at right angles with the line of projection, the picture will be distorted in proportion to the amount of departure from a right angle. This can be overcome by setting the top of the screen out from the wall, or whatever it is attached to, and drawing back the bottom, so that the right angle will be restored.

It is important to have as little extraneous light as possible in front of the screen; but if the foregoing suggestions are acted upon, unavoidable light will make a minimum of trouble.

THE "DAYLIGHT SCREEN"

The patented "daylight screen" differs from the ordinary screen in that it is placed between the projector and the audience, the picture being projected on the back and showing through the screen. This can be used where the projector can not be placed in front of the screen. Lack of space, difficult electrical connections or necessity for light in the room may make its use desirable. More room illumination can be used with the daylight screen than with the ordinary type, hence the name. A film to be projected on such a screen must be rewound before projection, with the celluloid or shiny side out.

OTHER DESIRABLE EQUIPMENT

EXTRA REELS

The projector operator should have at least six extra reels (fig. 1), in the best condition, for very much the same reason that every automobile should carry a spare tire. Very few film distributors send out films on best-quality reels. They claim that good reels often are not returned. It is a good rule, when the film user receives his shipment, immediately to rewind the films on his own reels, meanwhile carefully inspecting the films for bad splices, tears, or broken perforations. After the films have been used, transfer them to the original reels and save the good ones for the next showing.

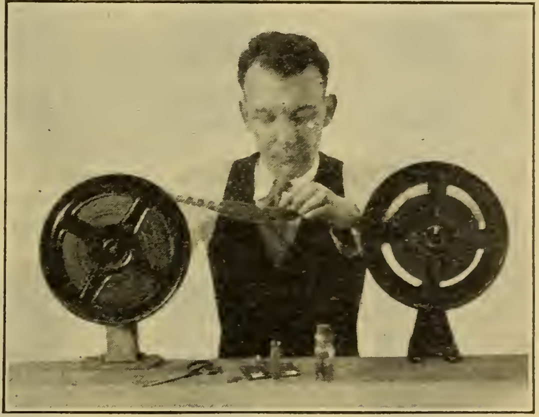


FIG. 2.—Every reel should be carefully inspected for faults before it is placed in the projector

An extra reel is also good to have at hand when there is a break in the middle of a show, for the film can be immediately threaded and operation resumed with less than a minute's delay.

REWINDERS

Every projector should have a rewinding set. (Fig. 1.) Even if a set of films be used only once, they should be given a preliminary inspection before they are trusted in the projector. The desirability of such inspections is a reason why the built-in rewinders, as found in some portable projectors, may be more of a detriment than a benefit. There is nothing like passing a film slowly over a pair of rewinders and allowing the fingers to detect faults that are likely to cause trouble in the precise mechanism of the projector.

In inspecting a film (fig. 2), look for broken perforations, for they can make much trouble by the catching of the jagged shreds, tearing the film, and sometimes causing a tangle of chewed-up celluloid among the sprockets. Broken perforations are repaired by

the simple expedient of cutting out a little triangular notch, just big enough completely to remove the ragged edges. This means cutting away the hole. Do not remove any more film than is absolutely necessary.

See that a short piece of film, similar to the leader, is cemented to the end of the picture. Otherwise the last few frames are in danger of being damaged every time the picture is run through the projector, resulting in the gradual shortening of the film.

SPLICING APPARATUS

If a film is broken, in the projector or otherwise, it must be spliced, joined, or patched, and the equipment necessary for this operation should always be near at hand.

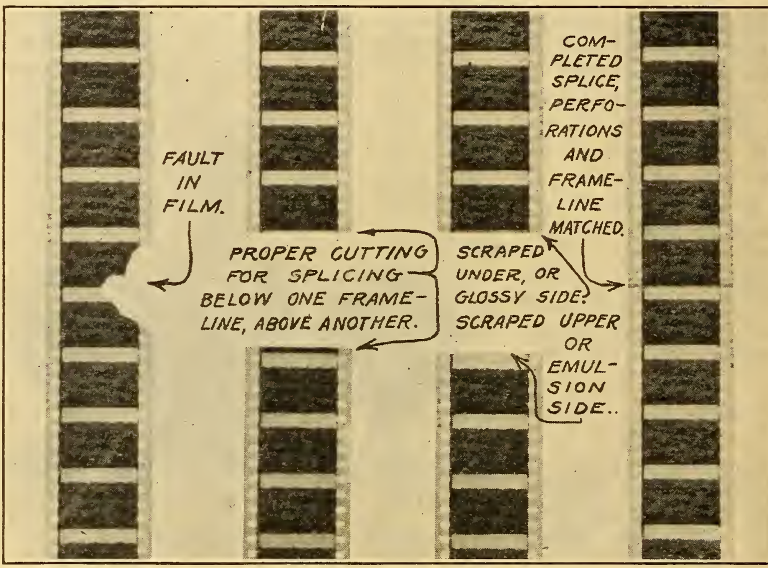


FIG. 3.—How to cut and splice a faulty film

It is possible to make splices with scissors, an old safety-razor blade, and film cement, but it is difficult to do the job quickly and accurately with only these tools. A poor splice seldom lasts. The least evil is a noticeable jump on the screen. If the work is done slowly the cement gets a chance to dry, and the splice will not hold. By all means invest in a mechanical splicer.

To patch a film, one of the torn ends is cut on the frame line (fig. 3), and the other is cut so that one sprocket hole beyond the frame line is left. The two ends are now overlapped, so that the frame lines and one pair of sprocket holes will exactly coincide (fig. 5). With a safety-razor blade, or other sharp instrument, scrape all the emulsion off the last end that was cut—that is, the end with a margin left beyond the frame line—first moistening the emulsion. (Fig. 4.) If the emulsion is not removed, and removed thoroughly, the cement will not hold. Do not remove emulsion beyond the patch area, however, as this causes a flash on the screen when the

patched frame passes through the projector. With the film lying emulsion side (dull side) up, give the scraped area a light, but unbroken, coat of cement (fig. 6); quickly and accurately overlap the ends; press down the patch with the finger, and clamp it in the splicer. (Fig. 7.)

Cleanliness is half the battle. Good cement and quick work are the other half. Film cement is not like glue. It is a solvent for celluloid and actually melts the surface on which it is spread, so that the joint is welded by the running together of the film instead of being stuck as by glue. So, if the joint is well made, it should be permanent. If too much cement is applied it will dissolve too much of the celluloid and leave the film thin and wrinkled. Drying is extremely rapid, which allows quick patching but necessitates rapid action to get the surface pressed together in time.

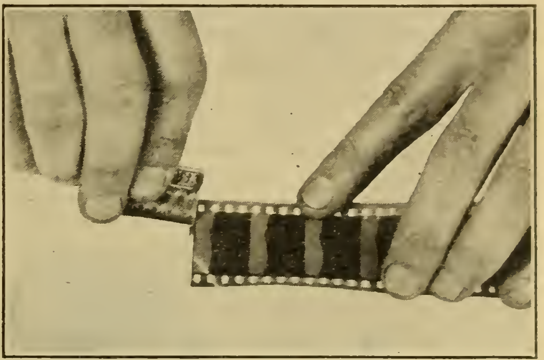


Fig. 4.—First step in splicing. Scrape emulsion side of film

If the operator handles both inflammable and slow-burning film, or "flam" and "nonflam," as they are commonly called, it will be necessary to see that the cement used is suitable for patching both kinds. Some cements are and some are not. Get the best cement to be had; poor cement is poor economy.

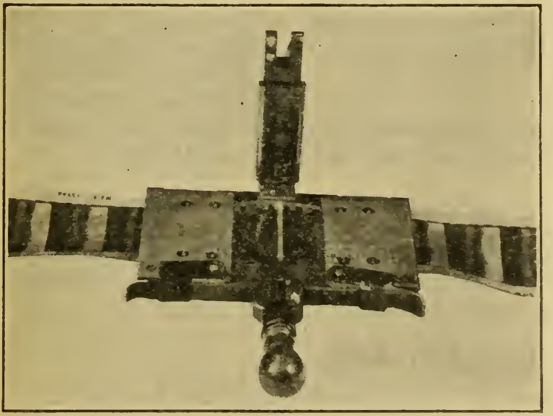


Fig. 5.—Second step in splicing. The film is scraped on the glossy side, and the two ends are overlapped and aligned in the splicer, perforation and frame lines being matched carefully

Cement for use with inflammable films, or with slow-burning films, or with either, may be obtained from most manufacturers and dealers in motion-picture supplies.

If a film breaks after passing through the gate, clip the ends together with an ordinary wire paper clip and run the film along to the take-up reel. If it breaks above the gate and it is not desired to take the time to patch on the spot, pull the broken end past the gate and the sprocket wheels, apply the paper clip, and complete the threading. Be sure to remove the clips and make proper patches before running the film again.

FLASHLIGHT OR OTHER AUXILIARY ILLUMINANT

Should you have trouble in operating your projector, a pocket flashlight prevents confusion and delay while the house lights are being turned on. With the flashlight you can search for the trouble. Such a light is almost essential in changing reels. Some extension agents make a Y connection on the projector, with a switch button and an extra bulb for "trouble shooting." *Never, never, never use matches for this purpose.*

FIRE EXTINGUISHER

A fire extinguisher should be effective in stopping a film fire in its early stages. A bucket of sand is probably even better. For a fire that gets beyond control, the best course is for the operator to carry the machine out of the building immediately, if possible.

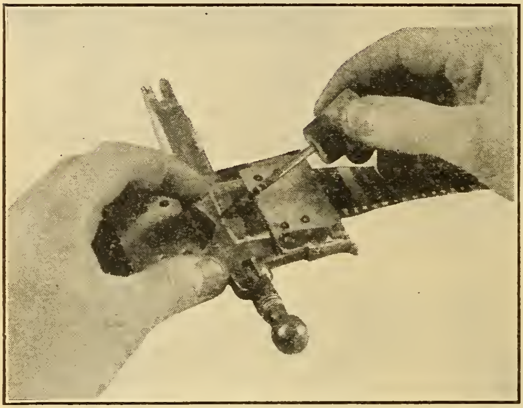


Fig. 6.—Third step in splicing. Cement is placed lightly on the scraped emulsion side and the other end of the film is placed on it

The greatest danger, however, is not fire damage, but panic. Therefore, *prevent fires. Use slow-burning films. Keep your projector in the best operating condition. Prohibit smoking near the films or near the projection machine.*

Never place films on a radiator. A fire might result, but there is another reason why this is bad. The heat may melt the splices or at least make the film brittle. Exposing a metal case full of films to a hot sun may do the same thing.

EXTRA BULBS

One or two extra bulbs for the projector are needed more than spare tires for an automobile. A punctured tire can be repaired, but a burnt-out bulb is gone forever.

FILM PROGRAMS

One standard reel of film requires 15 minutes for projection. From 1 to 3 minutes are usually required for changing reels in portable projectors. For most meetings four reels (requiring one hour) should be ample. An effective program for a general meeting would include something of particular interest to all ages likely to attend.

The film subjects should be chosen with first regard to the extension project on which stress is to be laid at the meeting. Hit

that subject as hard as the available films will allow. Either before or after the subject-matter film is shown, give the audience something of a different and perhaps lighter nature, not another heavy teaching subject that is likely to cause confusion in the results from the meeting.

If two projectors are available, waits between reels can be avoided. This is the system used in theaters for continuous shows.

The extension agent who intends to use films should arrive early at the meeting place and have his projector, screen, and other equipment in place before the crowd arrives. Items that frequently prove handy just at this time are a rope, hammer, and nails for hanging up the screen.

SPEECHES

As to the place of films on the program, there is a difference of opinion among agents. Some run films first and present speeches later; some do vice versa; and some have speeches between two groups of films. Many agents strongly advise that at least one film be kept for the final feature of the meeting.

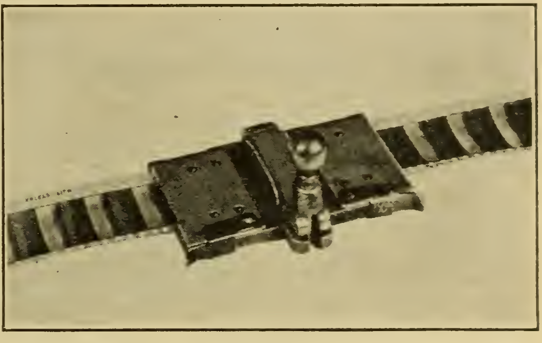


FIG. 7.—Fourth step in splicing. The splicer is clamped for a few seconds and the operation is finished

Do not have talks while the pictures are being shown. Even if the speaker attempts to speak with the film and amplify the points it contains it is almost certain that in the battle for attention neither of the contestants will win. If a film is well made, it carries the personality of its makers. The stronger the film the less adaptable it is to explanatory remarks as it is being shown. Refer to the film all you want before or after its actual exhibition.

One extension agent suggests the importance of impressing members of the local or community committee with their responsibility in arranging and carrying out the program. He advises that each talk be outlined in advance, so that the program will make a harmonious whole, that the talks be designed to fit in between reels of the pictures, and that an emergency speaker be ready to fill in when there is a film breakage or other delay. The extension agent will find it of great advantage to be assisted in such programs by a man who can look after such important details as the generator or the projector.

MUSIC

Music greatly enhances the value of a picture. Organ music, orchestra music, piano music, or even phonograph music, played while the pictures are being shown, will be found very helpful. The music should be soft and unobtrusive, not much more than an undertone, and should either definitely reflect the spirit of the films or be

of such a neutral tone as to harmonize with anything. The best motion picture accompaniment is that which the audience hears only subconsciously.

FIRE REGULATIONS AND PRECAUTIONS

When film is not in use it should be kept in a fireproof container, dry, but with some moisture available. A humidor container is good, and the same result can be attained by placing some blotters, dampened with glycerin, in an ordinary container. Do not expose the films to great heat, as they may burn, and are exceedingly likely to become brittle and break.

Some States and municipalities have such stringent regulations on the exhibition of motion-picture films that there is difficulty in using them nontheatrically. In some places the projector using standard-width film must be inclosed in a fireproof booth, and the operator of the projector must be licensed. There is a distinct trend toward more liberal regulations when safety or slow-burning film is used. Every prospective user of films, of course, should familiarize himself with the regulations he must observe. It is a good plan in many cases to interview personally the official who has charge of enforcing the regulations.

Motion-picture films are made in the standard theatrical width, and in several substandard or narrow widths. There are two kinds of film stock, the inflammable (cellulose nitrate) and the safety or slow-burning (cellulose acetate). All films circulated by the United States Department of Agriculture are of the standard theatrical width, 1⅜ inches or 35 millimeters. All new prints being manufactured by or for the Department of Agriculture are made on the slow-burning stock. Many other nontheatrical distributors have adopted the same policy.

SHIPPING INFORMATION

In returning films to the distributor by express or parcels post, be sure that you have the right films in the right container, that the container is addressed correctly, and that it bears a caution label, such as those sent out with each shipment of Department of Agriculture films.

The distributor will be appreciative if film users always return the films on time; not wound too tightly (tight winding sometimes causes scratches); not rewound (if rewound there is extra labor for the distributor in his inspection department); and with the right bands placed securely about the right reels.

DISTRIBUTION OF FILMS

The Department of Agriculture distributes most of its films from its motion picture laboratories in Washington, but urges that the State agricultural colleges or extension divisions take over this work within their respective territories. To such institutions and others the department offers a plan under which new prints of its films may be purchased at the manufacturing charge. Adoption of such a plan in all States would save the time and expense involved in shipments between Washington and all States of the Union.

SOME EASY ELECTRICITY

By Howard Greene

The following suggestions are intended particularly for agricultural extension workers beginning the use of motion-picture projectors, but may be found of value by others called upon to operate electrical appliances.

It is a simple matter to acquire sufficient knowledge of electricity to enable one to solve most of the more common electrical problems, to determine what sources of supply can or can not be used, and to avoid the dangerous cut-and-try method of finding out.

The simplest way to go at the problem is to think of electricity as water, and up to a certain point the analogy is sufficiently accurate.

AMPERES, VOLTS, WATTS

The quantity of water flowing in a pipe is measured in gallons; the quantity of electricity flowing in a wire is measured in *amperes*. The pressure of the water in the pipe is indicated in pounds per square inch; the pressure of the electricity in the wire is indicated in *volts*. A given quantity of water flowing through a pipe at a given pressure will, if put to work in a water wheel, produce a given amount of energy or power. A given quantity of electricity (amperes) flowing through a wire at a given pressure (volts) will, if put to work in a motor or lamp, produce a given amount of power or light. Water power is expressed in horsepower. Electrical energy is more commonly expressed in *watts*. A kilowatt is 1,000 watts. Direct comparisons are easily made, for 746 watts of electrical energy is the exact equivalent of 1 horsepower.

By putting these more or less dry facts to work it will not be difficult to get a grasp of their practical significance.

POWER

Water flowing through a pipe at low pressure will produce but little power if turned into a water wheel or turbine. Increase the pressure, however, and the power is proportionately increased. Keeping the same pressure, reduce the size of the pipe so that the quantity of water flowing is less, and the power goes down. There is the same pressure, but less water. Following out this principle, the quantity of water flowing can be decreased without decreasing the power developed if the pressure is increased sufficiently at the same time. In fact, the power can be increased, despite the smaller pipe, by still further increasing the pressure.

Working in the other direction, an increase in the quantity of water and a decrease in the pressure may still give the same power. There is less pressure, but more water.

It becomes clear, then, that the power obtained is due to the combination of pressure and quantity.

Electricity works in the same way. A small quantity (small number of amperes) at high pressure (voltage) will, given the right proportions, produce the same power (wattage) as a large amperage at low voltage.

A little condensed tabulating will help in remembering

	Water	Electricity
Quantity or rate of flow	Gallons	Amperes.
Pressure	Pounds	Volts.
Power or energy	Horsepower	Watts.

SIMPLE CALCULATIONS

With the foregoing facts in mind it becomes very easy to make the calculations ordinarily required and, as will appear, no profound knowledge of mathematics is necessary.

Having found that power (wattage) is the result of a combination of quantity (amperage) and pressure (voltage), to find the wattage it is only necessary to multiply the volts by the amperes; the product is *watts.*

Thus, a current of 10 amperes at 110 volts figures out this way:

$$10 \times 110 = 1{,}100 \text{ watts.}$$

If the amperage and the wattage only are known, the voltage can be at once obtained by dividing the watts by the amperes, thus:

$$1{,}100 \div 10 = 110 \text{ volts.}$$

If only the voltage and the wattage are known, the amperage can be obtained by dividing the watts by the volts, thus:

$$1{,}100 \div 110 = 10 \text{ amperes.}$$

By this simple three-cornered bit of arithmetic, a knowledge of any two factors makes it easy to find out what the third is.

PRACTICAL APPLICATIONS

Let us now see what practical use can be made of these rules.

Suppose it is desired to operate a portable motion-picture projector, using a 900-watt 32-volt lamp, and it is necessary to obtain the electrical energy from storage batteries. By connecting three 12-volt batteries, or six 6-volt batteries, in series, the requisite voltage or pressure can be obtained; the odd extra voltage is not sufficient to make any material difference and, in fact, will probably be absorbed by the resistance of cables. But now arises the question of amperage. It is necessary to find out what quantity of current the lamp will draw, and see if the battery has sufficient capacity for the work. Knowing the wattage and voltage of the lamp, and applying the rule, it is found that the " draw " is 28.12 amperes—($900 \div 32 = 28.12$). Referring to the data plate on the battery case, it is found that the capacity of the battery is 80 amperes. Therefore it looks as though there should be sufficient current in the battery to keep the lamp going for nearly three hours.

AMPERE HOURS

Here, however, another factor enters. When a battery is said to have a capacity of 80 amperes, it means that it will deliver 1 ampere for 80 hours or 10 amperes for 8 hours, or 20 amperes for 4 hours, etc. In fact, the correct way to express battery capacity is so many ampere-hours. If we have a tank holding 80 gallons of

water, we can draw off water at the rate of 1 gallon an hour for 80 hours, or 10 gallons an hour for 8 hours, or 20 gallons an hour for 4 hours. Just so with the battery; think of it as a tank of electricity, and think of amperes as gallons, and there never need be any confusion or difficulty.

As a battery is not a tank but a sort of chemical laboratory, however, there is one respect in which the analogy does not quite hold good. If the electricity is drawn off very rapidly, the total will fall a little short of 80 amperes; if it is drawn off very slowly we may get a little more than 80 amperes. In order to standardize matters it is usual to give the capacity of a battery as so many amperes drawn off, or discharged, in a given time; often this is four hours. So we will get 80 amperes total if we draw 20 amperes for four hours. If we draw more slowly we may get a slightly higher total, and if more rapidly a lower total. It is inadvisable, however, to exceed the normal rate, and draining the battery to the bottom, so to speak, is injurious to the plates, as is also too rapid a discharge.

Coming back to the 900-watt lamp and the 80-ampere-hour battery, it develops that the battery will have to work beyond its normal rate to keep the lamp supplied with current. Figuring in the small quantity of current required to drive the motor, the battery will be called upon to discharge at about a 29-ampere rate, and, allowing for the drop in efficiency owing to the rapid discharge, and the falling off near the end of the discharge, it would not be safe to figure on much more than two hours of continuous work. So we must look for a more capacious tank of electricity. If we can get a battery of 120 ampere-hours capacity, it figures out much better. At the four-hour discharge rate it is possible to draw at the rate of 30 amperes. As we need a little less than that, it is safe to assume that we can run continuously for four hours, with little or no weakening at the end of the time. The same principles and the same rules can be applied to other lamps and other batteries.

EXCESS AMPERAGE

If we have a lamp requiring say 30 amperes, and it is connected to a supply capable of delivering 50 or 100 or 200 amperes, what is there to prevent an unlimited number of amperes from shooting through the lamp and burning it out? This is a point that often is puzzling.

The answer is that the lamp (and this applies equally to motors) can not take more than it needs, no matter what the capacity of the source of supply may be, unless the normal *voltage* for that lamp is exceeded. The resistance of the lamp filament, or of the motor winding, is so calculated that under normal conditions no more than the required amperage, or quantity, can be pushed through.

COMBINING THE POWER OF SMALL BATTERIES

Without possession of a storage battery of sufficient capacity and with no other source of electric current available, it may be possible to obtain a number of low-amperage batteries (for instance, by borrowing the batteries from several automobiles). Though no one of these batteries may have high enough amperage, a current sufficient

to operate the machine might be obtained by connecting the batteries and using their combined capacity.

Now if two or more batteries are connected in series—that is, the positive side of one to the negative side of the next, and so on—the quantity (or amperage) of electricity available is not increased, but the voltage becomes equal to the added-up voltage of all the batteries. For instance, if six six-volt 80-ampere batteries are connected in series, we get 36 volts and 80 amperes. Figure 8 shows the method of series connection:

But it is a poor rule that will not work both ways. A number of batteries can be so connected that we will get the voltage of one and

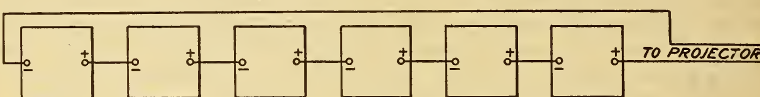


FIG. 8.—Six batteries in series—amperage = amperage of one battery; voltage = total number of batteries × voltage of one battery

the added-up amperage of all. This is called parallel connection. All the positive binding-posts or terminals are connected to one wire, and all the negative terminals to another, the wires, of course, being the leads to the projector or other electrical apparatus to be operated. Now, if we hook up two 6-volt batteries in parallel the voltage in the line wire will be equal to that of one battery (6 volts) but the amperage will be equal to that of two batteries (160 amperes). With six batteries we would get 6 volts and 480 amperes, and so on. Figure 9 shows the method of parallel connection:

These two methods of connection can be combined in what is called *series-parallel* or *series-multiple* connection, which makes it possible to obtain a number of combinations of voltage and amperage.

Series-parallel or series-multiple connection consists in dividing the batteries into groups, each group having its batteries connected

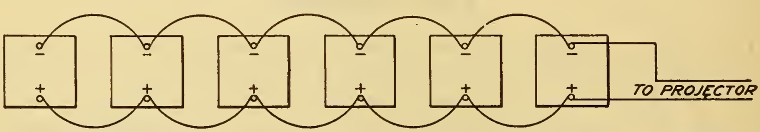


FIG. 9.—Six batteries in parallel—amperage = amperage of one battery × total number of batteries; voltage = voltage of one battery

in series, and then connecting the groups in parallel. This may sound somewhat formidable, but it is very simple when it comes to actually doing the job.

Suppose we have twelve 6-volt 80-ampere batteries to be connected in series-parallel in two groups. Figure 10 shows how to do this.

The two groups must be connected in this way—the two positives together, at one end of the groups, and the two negatives together at the other end. A mistake in these connections might ruin the batteries in a very few minutes.

Finally, the wires leading to the projector are connected, one to either one of the two positive terminals that are connected together, and the other to either one of the negative terminals that are connected together.

RESULTS FROM "HOOK-UP"

Now let us see what results from this method of hooking up batteries. Twelve 6-volt batteries connected in series would give the amperage of one battery (80) and the voltage of all twelve added up (72). But the same batteries, divided into two groups and connected in series-multiple, will give—

160 *amperes.* Because amperage=number of groups multiplied by amperage of one battery.

36 *volts.* Because voltage=number of batteries in a group multiplied by voltage of one battery.

The voltage and amperage of any even number of batteries, connected in series-multiple, can be calculated in the same way.

HOW TO MAKE THE CONNECTION

The actual work of making connections can be simplified by using the line wires—that is, the wires leading to the projector—for con-

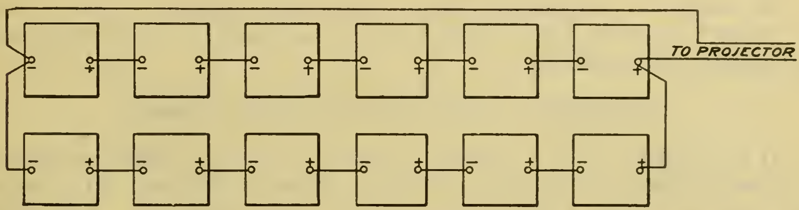


FIG. 10.—Twelve batteries in series-parallel or series multiple—amperage=amperage of one battery × number of groups; voltage = voltage of one battery × number of batteries in one group

necting together the end batteries. Set out the two groups of batteries in two rows, with two positive terminals at one end and two negatives at the other. Make the series connections with short pieces of wire. Then connect one of the line wires to one of the negative end terminals and carry the same wire across to the other negative terminal and connect it, removing the insulation for a couple of inches so that the bare wire can be slipped under the binding-post and clamped down. Then with the other line wire do exactly the same at the positive end.

ELECTRICAL PROTECTION

Practically all electrical apparatus is so constructed that it will operate, without sustaining damage, upon slightly heavier amperages and higher voltages than normal. In the case of a motor, the power will be augmented and in the case of a lamp, the filament will burn somewhat more brightly. This leeway is limited, however, and it is dangerous business to take any liberties with it. Normal ratings should be adhered to as closely as possible. As it is easier to appreciate and guard against a danger that is understood, it may be well to explain briefly the effects of excessive currents.

EFFECTS OF TOO MUCH CURRENT

The passage of an electric current through any electrically-operated device always causes heating. In some cases this heating is intentional and necessary, as in the case of a lamp, which gives light solely because of the glow of the filament heated by the passage

of current through it. In some cases it is an inescapable nuisance, as in a motor. In some cases the heating is so slight as to be imperceptible. But it is always there.

When excessive current is applied to a lamp the filament disintegrates and goes to pieces; it does not actually burn, because there is no oxygen in the bulb. The disintegration may be only partial—it may not effect the brilliancy of the lamp, but the effect will appear in the form of reduced life—or the lamp may be snuffed out in an instant. In any case, more or less harm is done.

Whenever the lamp is caused to burn beyond its normal brilliancy its life is shortened by a time depending upon the quantity of excess current and the time for which it is applied.

When excessive current is applied to a motor the windings are overheated and, if the overheating is sufficient, the insulation of the windings will be burned or charred and the solder, where the armature windings are connected to the commutator, will melt and cause open circuits.

No harm can be done to lamp or motor if the voltage of the current is correct, no matter how many amperes the battery or generator may be capable of supplying.

PREVENTING DAMAGE FROM EXCESSIVE CURRENT

It is a comparatively simple matter to provide absolute protection against damage or burning out from excessive current. It is necessary only to insert a fuse of the proper value in the line. Any dealer in electrical supplies can supply, at very low cost, a fuse block and a few extra fuses. This fuse block should be connected in such a way that the fuse forms part of one of the supply lines; for instance, one of the line wires might be cut and the two ends connected to the fuse block. A more convenient arrangement would be to put the fuse block inside the projector case. But any arrangement will answer the purpose as long as the fuse is in the supply line.

Where a projector is used exclusively on a city supply of current, or on a farmhouse-lighting system or the like, where the current value is known and where fluctuations do not occur, a fuse in the projector line is of little or no value and is rarely used. It is true that an accidental short circuit might cause a sudden abnormal flow of current by cutting down the resistance; but this would be taken care of by the fuses in the lighting system from which current was drawn.

LOW VOLTAGE

It sometimes happens that only 32-volt current is available, though the machine requires 110—or vice versa. If means are provided for hand cranking, a hitch can be avoided by doing this and using a lamp of a voltage to suit the pressure of the line.

SUGGESTIONS ON PORTABLE GENERATORS

Portable generators differ widely in their construction, operation, and characteristics. Some types are fitted with automatic voltage regulators, so that the current supply is steady and dependable. Others must be carefully watched. In the case of generators driven from automobile engines, either directly or by a belt passing over

one of the rear tires, it usually is necessary to regulate the engine speed with a good deal of care.

An important point in this connection is the fact that when the engine is started cold it will not run so fast as it will a little later, when it gets well warmed up. Therefore, if the throttle and spark are set for a speed that will cause the generator to deliver current at the proper voltage immediately after starting the engine, it is probable that the subsequent increase of speed owing to the warming up of the cylinders will result in an increase of voltage. Some engines will show a greater variation in this respect than others. In any case the engine should be held down to a safely low speed until it has reached something like its normal running temperature. As a rule it is necessary to run the engine at rather a low speed, and its action is not quite as steady as at higher rates. In most cases, however, a little experimenting will reveal a carbureter setting that will give a good, steady speed at the proper rate for the generator, and it will pay to use this carburetor setting when the generator is in use.

KEEP GENERATOR CLEAN AND OILED

A generator is a machine that thrives best on being let alone as long as its few simple needs are supplied. It must, however, be kept clean, and it must be kept lubricated. Part of the business of keeping it clean consists in keeping oil confined to the places where it is needed and not allowing it to spatter over the commutator and windings.

Oil in the windings of a well-built generator, or, for that matter, a motor, may do no particular harm at first. In time, however, it is likely to soften the insulation and cause slowly developing short circuits. Oil on the commutator is a good deal more immediate in its effects. It will at once cause sparking. The heat of the little arcs (sparks) will cause the oil to gum or harden in little specks on the copper bars, roughen the surface, and cause still more sparking. The commutator will wear more rapidly than it should and the brushes will soon wear down.

The moral is that oil in the right place, which is on the bearings, is essential, but oil in the wrong place is at least a nuisance and may cause disaster.

THE COMMUTATOR

The condition of the commutator is of extreme importance. It is well, therefore, to know how a commutator looks when it is in good condition. It should, of course, be perfectly smooth, the surface broken only by the insulated spaces between the bars or segments; and where the brushes make contact the copper should be glossy and " slick " and of a dark-brown or bluish-brown color. The idea that the commutator should be of a bright polished copper color under the brushes is entirely wrong. A commutator in good condition is to be treated with respect, as a thing of value, which it is. It should be wiped with a soft cloth—not waste, and not an oily rag—after each run, and nothing else done to it as long as it stays that way. And it is not likely to show any change for a long time.

If a commutator is in bad condition, the sooner it is made right the better. If it is grooved by the wear of the brushes, or if it is worn

"out of round," it should be sent to an electrical repairman for turning. If it is not much worn, but shows specks, pits, and scratches, proceed as follows:

Remove the brushes, or catch them up in the brush holders so they will be well clear of the commutator. Take a strip of fine sandpaper of about the width of the commutator, lay it over the commutator so that it wraps about half the surface, just as a belt would be laid over a pulley, hold the sandpaper by the ends and get some one to turn the generator shaft. Keep this up until the copper is as smooth and clean as possible.

Now reverse the sandpaper so that the sand side is out and the paper side is next to the commutator. Let one of the brushes down on the sandpaper. Turn the commutator to and fro part of a revolution, so that it carries the sandpaper with it and causes it to rub on the contact surface of the brush. A couple of dozen oscillations will thoroughly clean and resurface the brush and, what is important, its curvature will not be destroyed. Clean all the brushes in the same way. As a rule there are only two. Wash off commutator and brushes with a rag well moistened with gasoline, and then wipe off with a soft, clean cloth. Take the greatest pains to clean away every trace of grit resulting from the use of the sandpaper.

Do not under any circumstances use emery cloth or emery paper for cleaning commutator or brushes. The grit embeds itself in the carbon of the brushes and in the copper of the commutator, and it is extremely difficult to get rid of; it causes scars and scratches and spoils the chance of working up a good, glossy-brown surface.

It is worth while to take good care of the commutator, for if it is not in good condition an unsteady current, and consequently an unsteady light, will inevitably result, no matter how well the generator may be working otherwise.

CABLES

When using portable projectors it is well worth while to use heavy, well-insulated cables and heavy and substantial connectors. Screw connectors of the lamp-socket type are wholly unsuited to this service, and will give trouble in a short time if used often.

Lamp cord, even of the most substantially insulated type, is good only where the service is light and the length of cable is short. For hard and continuous work, and where the distance from generator (or battery) to projector is considerable, use heavier cable and more rugged insulation. There are various kinds of cable that will answer the purpose. A double conductor (two wires running together) makes the least troublesome and most durable cable and is not nearly as likely to tangle up and kink as a single conductor run double. As to the size of the wire, No. 14 is none too heavy for moderately long reaches and No. 12 is better. Good, big wire always has the double advantage of being substantial and lasting, and of carrying the current without serious drop in voltage. Small wire will pull down the voltage to an extent that is rather surprising, and this makes a real and practical difference in results, especially if the normal voltage is no more than sufficient.

O